



FUGRO GEOSPATIAL, INC.

Accuracy Report

SD_Southwest_NRCS_2018_D18

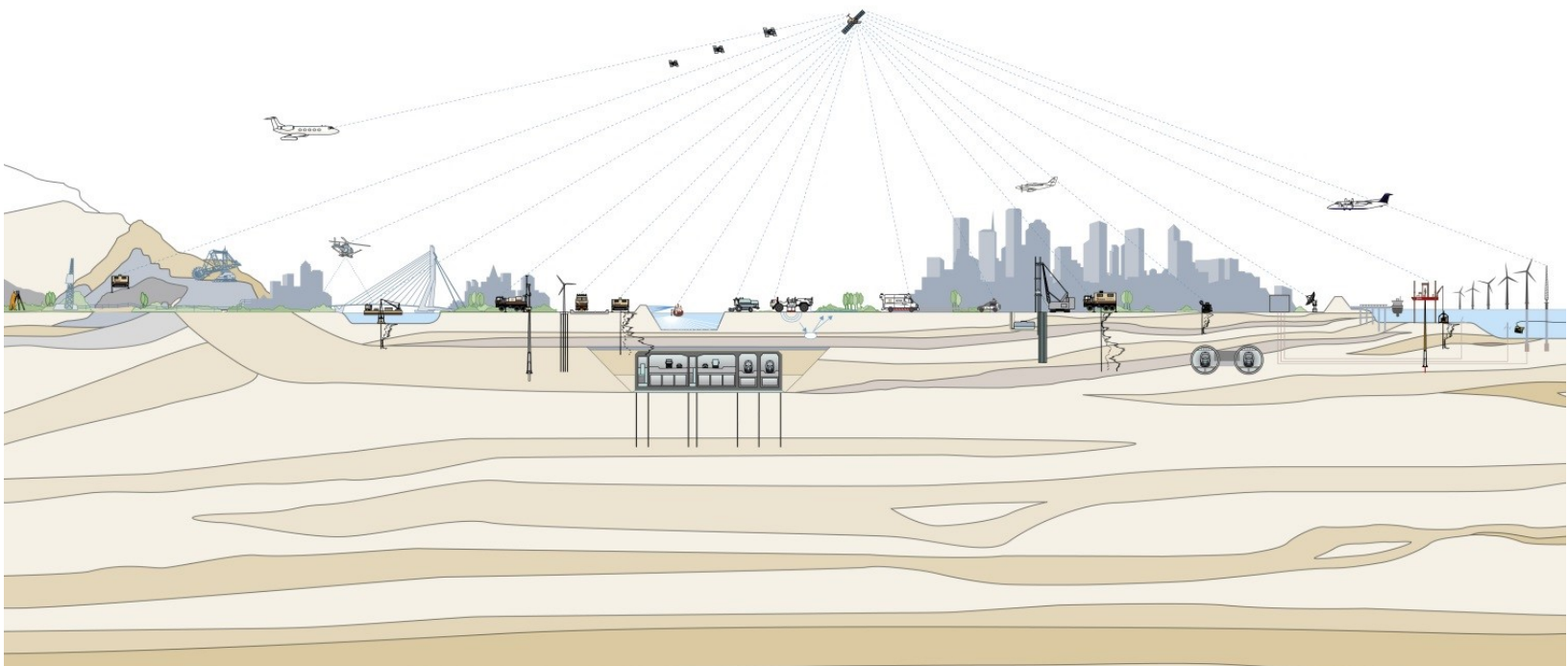
Block 2

Prepared for:

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1. ACCURACY REPORTING

Data collected under this Task Order meets the National Standard for Spatial Database Accuracy (NSSDA) accuracy standards. The NSSDA standards specify that vertical accuracy be reported at the 95 percent confidence level for data tested by an independent source of higher accuracy.

1.1 Positional Accuracy

Before classification and development of derivative products from the point cloud, the absolute and relative vertical accuracies of the point cloud were verified.

1.2 Absolute Vertical Accuracy

Unclassified Lidar Point Cloud Data: The Non-Vegetated Vertical Accuracy (NVA) of the Lidar Point Cloud data was calculated against TINs derived from the final calibrated and controlled swath data. The required accuracy (ACC_z) is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on $RMSE_z$ of 10 cm in the “open terrain” and/or “Urban” land cover categories. This is a required accuracy. Please refer to the table below for the achieved accuracies. The raw swath point cloud data met the required accuracy levels before point cloud classification and derivative product generation.

Table 1: Accuracy of the Lidar Point Cloud Data

Raw Flight Lines	$RMSE_z$ (non-vegetated)	NVA at 95-percent confidence level
Specification (cm)	≤ 10	≤ 19.6
Calculated Values (cm)	5.4	10.6
<i>Specification (m)</i>	≤ 0.100	≤ 0.196
<i>Calculated Values (m)</i>	0.054	0.106
Number of points	58	58

Bare Earth Surface: The accuracy (ACC_z) of the derived DEM was calculated and is being reported in three (3) ways:

- 1. $RMSE_z$ (Non-Vegetated):** The required $RMSE_z$ is ≤ 10 cm.
- 2. Non-Vegetated Vertical Accuracy (NVA):** The required NVA is: ≤ 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on $RMSE_z$ of 10 cm in the “open terrain” and/or “Urban” land cover categories. This is a required accuracy.
- 3. Vegetated Vertical Accuracy (VVA):** The required VVA is: ≤ 29.4 cm at a 95th percentile level, derived according to ASPRS Guidelines, Vertical Accuracy for Reporting LiDAR Data, i.e. based on the 95th percentile error in Vegetated land cover categories combined (Tall Grass, Brush, Forested Areas). This is a required accuracy.

Please refer to the table below for the achieved accuracies.



Table 2: Accuracy of the Derived DEM

DEM	RMSE _z (non-vegetated)	NVA at 95-percent confidence level	VVA at 95th percentiles
Specification (cm)	≤ 10	≤ 19.6	≤ 29.4
Calculated Values (cm)	5.4	10.7	15.4
<i>Specification (m)</i>	<i>≤ 0.100</i>	<i>≤ 0.196</i>	<i>≤ 0.294</i>
<i>Calculated Values (m)</i>	<i>0.054</i>	<i>0.107</i>	<i>0.154</i>
Number of points	63	63	44

1.3 Relative Accuracy

Smooth Surface Repeatability: In ideal theoretical conditions, smooth surface repeatability is a measure of variations documented on a surface that would be expected to be flat and without variation. Users of lidar technology commonly refer to these variations as “noise.” Single-swath data was assessed using only single returns in non-vegetated areas. Repeatability was evaluated by measuring departures from planarity of single returns from hard planar surfaces, normalizing for actual variation in the surface elevation. Repeatability of only single returns was then assessed at multiple locations within hard surfaced areas (for example, parking lots or large rooftops).

Each sample area was evaluated using a signed difference raster (maximum elevation – minimum elevation) at a cell size equal to twice the ANPS, rounded up to the next integer. Sample areas were approximately 50 square meters (m²). The maximum acceptable variations within sample areas for this project is 6 cm. Isolated noise is expected within the sample areas and was disregarded.

The evaluation was done on 26 flat open sample areas over the SD2018_D2 AOI. The result is shown in the table below, please also refer to *SD2018_D2_Relative_Accuracy_Smooth_Surface_Repeatability.shp*.

Table 3: Relative Accuracy, Smooth Surface Repeatability

Max_DZ (m)	Area (sq m)
0.0421	85
0.0450	80
0.0449	91
0.0530	81
0.0380	79
0.0460	94
0.0470	90
0.0460	95
0.0410	91
0.0400	81
0.0400	77
0.0600	94
0.0400	96

Max_DZ (m)	Area (sq m)
0.0400	90
0.0400	95
0.0600	98
0.0560	97
0.0420	95
0.0500	90
0.0500	99
0.0391	71
0.0431	95
0.0500	90
0.0509	90
0.0480	89
0.0391	95

Overlap Consistency: Overlap consistency is a measure of geometric alignment of two overlapping swaths; the principles used with swaths can be applied to overlapping lifts and projects as well. Overlap consistency is the fundamental measure of the quality of the calibration or boresight adjustment of the data from each lift, and is of particular importance as the match between the swaths of a single lift is a strong indicator of the overall geometric quality of the data, establishing the quality and accuracy limits of all downstream data and products.

Overlap consistency was assessed at multiple locations within overlap in non-vegetated areas of only single returns.

Each overlap area was evaluated using a signed difference raster with a cell size equal to twice the ANPS, rounded up to the next integer. The difference rasters are visually examined using a bicolor ramp from the negative acceptable limit to the positive acceptable limit. Although isolated excursions beyond the limits are expected and accepted, differences in the overlaps shall not exceed the following limits:

1. Swath overlap difference, $RMSDz \leq 8$ cm
2. Swath overlap difference, maximum ± 16 cm

The difference rasters are also statistically summarized to verify that root mean square difference in z (RMSDz) values do not exceed the. Consideration will be given for the effect of the expected isolated excursions over limits.



The result of the evaluation over 31 samples throughout the SD2018_D2 AOI is shown in the table below, please also refer to *USGS_SD_Delivery_2_Relative_Accuracy_Flightline_Overlap.shp*.

Table 4: Relative Accuracy, Overlap Consistency

RMS_DZ (m)	Max_DZ (m)	Min_DZ (m)	Area (sq. m)
0.0181	0.0615	-0.0746	482
0.0403	0.0929	-0.0168	484
0.0140	0.0392	-0.0645	470
0.0118	0.0330	-0.0672	480
0.0254	0.0722	-0.0888	515
0.0536	0.1009	-0.0032	462
0.0124	0.0426	-0.0444	486
0.0354	0.0667	-0.0046	475
0.0488	0.0795	0.0222	481
0.0211	0.0150	-0.0540	445
0.0449	0.0761	-0.0186	457
0.0197	0.0597	-0.0399	492
0.0151	0.0387	-0.0476	452
0.0132	0.0271	-0.0483	450
0.0229	0.0076	-0.0610	452
0.0142	0.0294	-0.1087	427
0.0351	0.0092	-0.0652	488
0.0403	0.0074	-0.1184	433
0.0334	0.0175	-0.0897	436
0.0546	0.0930	0.0056	475
0.0416	0.0865	0.0005	496
0.0142	0.0299	-0.0456	475
0.0173	0.0225	-0.0608	476
0.0519	0.1014	-0.0023	451
0.0188	0.0566	-0.0499	495
0.0189	0.0252	-0.0619	496
0.0225	0.0407	-0.0606	441
0.0210	0.0540	-0.0774	469
0.0160	0.0584	-0.0428	441
0.0298	-0.0073	-0.1298	478
0.0134	0.0501	-0.0363	424